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## Electric Railways.—IV.

(*Continued from page* 181.)

Up to the present time the industrially-worked electric railways have all been upon the "parallel" plan. That is to say, the electric current has been conveyed to the motors on the line by division between them. The electrical energy for each motor has been apportioned to it by division of the ampères generated at the dynamo.

Whether this plan is practically better than the "series" system, which divides its electrical energy among the motors on the line by division of the volts, remains to be determined by extended practical use.

There is one important factor which is in favor of the series system, namely *resistance*. The member of the equation which expresses the power consumed in passing electric current through resistance is written $C^2 R$. This is also equivalent to $e\ C$. This latter is derived, in the case of determining the difference of potential between the extremities of a resistance, from the formula $C\ r = e$. These symbol letters are those used in expressing Ohm's law: $E = C\ R$. The small $e$ is used for sub-differences of potential, as between points of an external circuit.

Let us consider then, for an example to illustrate the absorption of energy, and its equivalent expenditure of power, an electric railway having a resistance of 10 ohms, other than that of its motors and dynamo. This is extremely large, but convenient for illustration. It is plain that the power requisite to transmit electric energy through that resistance is wasted, so far as any useful effect in locomotion is concerned. Now, if one motor be intercalated within that resistance, or in other words, one of our locomotives requiring 74.6 ampères of current be run upon the track, the consumption of energy in that resistance is expressed by

$$\frac{C^2 R}{746} = \frac{74.6^2 \times 10}{746} = 74.6$$

horse-power. This is the case under both systems.

Let us add another like locomotive in each case, and we at once observe a great variation.

In the series system the current remains the same in ampères, and the line resistance is unaltered, therefore the energy absorbed by the line remains the same, though its percentage of the power expended is now only one half that which it was in the first case. This points toward economy in transmission of the energy required for the motors, because the percentage of loss for that purpose is decreased by each addition to the number of operating locomotives.

In the parallel, or multiple-arc, system the additional locomotive requires the current to be equally increased. Now it is 149.2 ampères, and the consumption of energy on the line is expressed by this equation:

$$\frac{2C^2 R}{746} = \frac{149.2 \times 10^2}{746} = 298.4 \text{ horse-power.}$$

We perceive that the energy consumed by the line, independent of the motors, is in proportion to the square of the number of locomotives supplied with current, in the case of the parallel system.

Of course, this loss can be obviated by decreasing the resistance of the line in the ratio of the square of the number of locomotives, thus:

$$\frac{2C^2}{746} \times \frac{R}{2^2} = \frac{149.2^2 \times 10}{746 \times 4} = 74.6 \text{ horse-power.}$$

But this procedure is costly, because it requires an increase in the cost of conductors in the proportion of the square of the number of locomotives operated at once. Provided, always, however, that the conductivity of the parts of the track used for conductors is only right for one locomotive at the start. But this element for consideration becomes of more importance with each addition, no matter how large it may have first been made. To make the track unnecessarily heavy, not for sustaining the traffic, but for use as electric conductors, seems to be a waste to be avoided if possible.

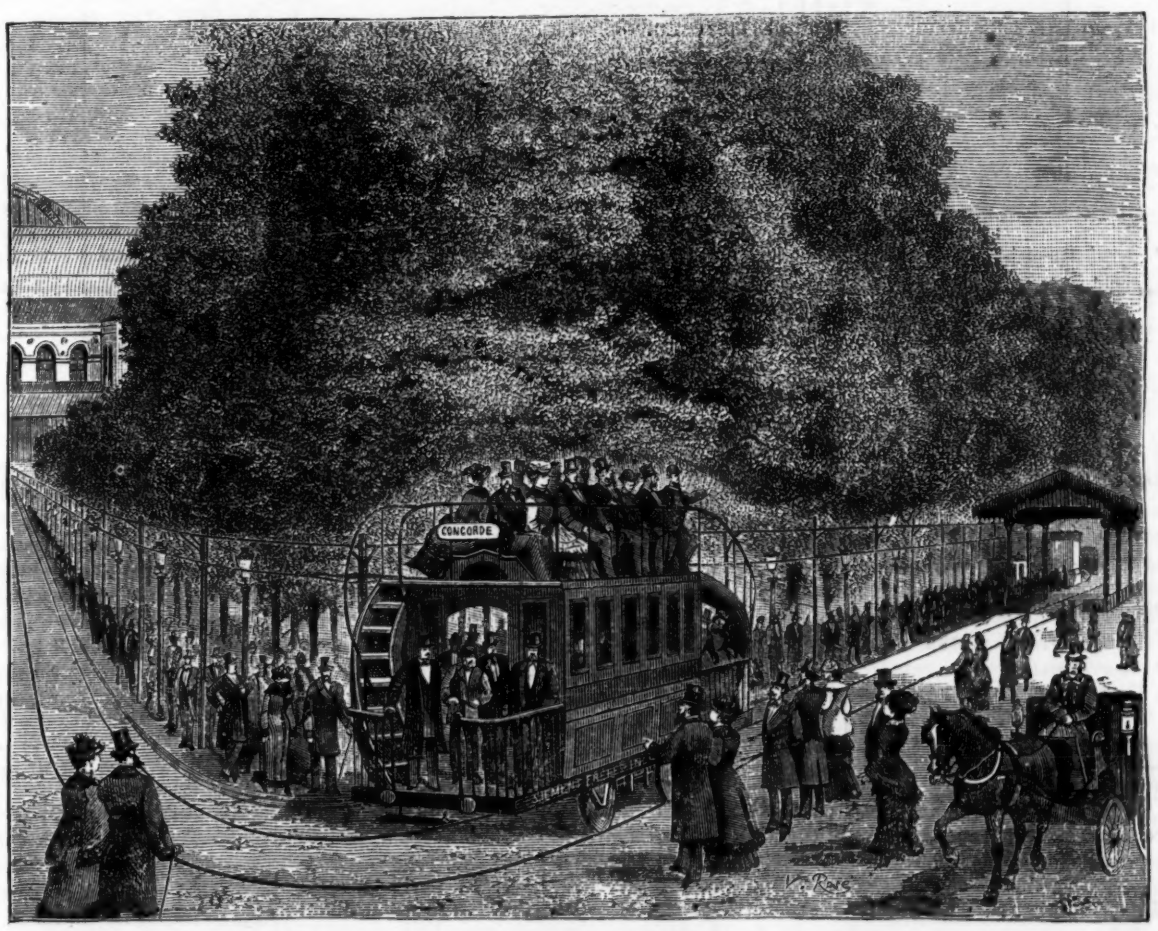
It is evident, then, that the increase of numbers of locomotives on a track of a parallel system is practically limited by two factors, namely: Cost of power used with small conductors, on the one hand, and the cost of conductors, when power is saved, on the other. Engineers can figure out the happy medium between daily cost for power and that for interest and wear and tear on plant and conductors, in determining the economical parallel-system road.

It also seems that, having determined the size of conductors, whether the track, or other, no change in *that particular* need be made in case of additions to the number of locomotives operated at once under the series system; and that the percentage of loss in conductors *decreases* with additions to the series, and that it *increases* with additions to the parallel.

The waste of energy due to resistance of the conductors, or idle portions of the circuit, being of continual growth with use, and dependent upon the resistance as a factor, it is necessary for economy to make the factor as low as practically expedient. Therefore the electric-railway engineer endeavors to so construct his conductors between dynamo and motor that he may have the least practicable resistance therein. This he effects by the use of suitable materials which he joins together where necessary by the most approved connectors, as in other electric circuits. We are constrained to say, however, that no greater care has been practically bestowed in this matter than has been in the case of telegraph and telephone circuits. We have seen single-line connections in telegraph wires which had several hundred, and even one thousand, ohms resistance owing to imperfect contact. The lines having these excessive extra resistances were made operative by the expenditure of extra battery power. This is small to one line, to be sure, but multiplied by many lines the expense becomes a serious one to a telegraph company.

Of course, a like resistance in an electric railway circuit would be practically infinite in its case, destroying all possibility of locomotion, and would not be allowed to exist. But one-one-hundredth of an ohm at any connection in an electric-railway circuit would be too great and would absorb energy, which would be unnecessary if it did not exist. In cases where rails are used to convey the current there is a great liability to occurrence of such imperfect connections, especially when dependence is placed alone upon the fish-plates used for bending the rails into one continuous track. The iron or steel rails and fish-plates are exposed to the action of air and water so that they rust. This rust accumulates between the points, serves to destroy their contacts, and to that extent increases the resistance.

From that and other causes other conductors and materials therefor have been used. These we will consider under the proper head, our purpose at present being to consider resistance in the abstract as related to the consumption of power or loss of energy, and to the economy of any system of electric railways.




ELECTRIC TRAM CAR, USED DURING THE PARIS ELECTRICAL EXPOSITION.

Another way for loss of energy is through defective *insulation*. Let us consider a case such as a track laid as on an ordinary railroad, on ties imbedded in a gravel bed, but with the fish-plates joining the rails in good electric connection, and the rails connected one side with the positive and the other side with the negative binding-posts of the dynamo through any suitable conductor. The rails thus become the two poles of the dynamo, and arranged parallel but a short distance apart for say miles of length. As in the cases we have been assuming for illustration, the difference of potentials between the rails is 100 volts. Of course the resistance of any one tie, or of the earth between two ties and the rails, if all be ordinarily dry, is great enough for that tie or section of earth to be considered a good insulator. But such resistance is not infinitely large; it conducts a portion of the current, and that portion which is due to the 100 volts tension divided by the resistance of the tie and earth. When we come to divide the resistance of such a section of conductor by the thousands of such sections in miles of road in order to arrive at the resistance of the insulation of the rails, we may find that the loss by conduction across from rail to rail to be a serious one. This is *leakage* from which we get no return.

If these things be absolutely dry then the rails are insulated as well as they can practically be. However, even in the dryest weather there is some moisture in ties and earth of a railway, tending to destroy insulation; and in wet weather a line of any considerable length would be completely short-circuited, enough so that no locomotive would receive sufficient current from the rails to run it.

In cases of rails imperfectly insulated from ties and ground there is also a tendency to deterioration of one rail by reason of the electrolysis of the water. One line of rails is positive, and as such is an anode at which the water present is decomposed into its constituent elements, and the

oxygen constituent combines with the iron to form oxide of iron, or rust. The other rail is negative, and as such is a cathode at which the water present is decomposed into its constituent elements, and the hydrogen escapes thereat as a gas, though the rail is protected from rust, or oxidation.

Electric-railway engineers have further insulated the rails from the ties and ground by placing sheets of vulcanite or other non-conducting material between the rails and ties, and between the rails and the spikes which fasten them to the ties, and further by removing the earth from under the rails. In wet weather this is still somewhat insufficient, because there is some leakage by way of the films of water which gather on the surfaces of the insulating sheets or materials.

Some have used a third rail, placed between the usual two, to conduct to the motors the current which is returned to the dynamo by the outer rails and ground. This rail, not being used to sustain the car or train, has been, or can be, better insulated from the return conductors and ground than it is possible to provide and maintain in the case we have been considering.

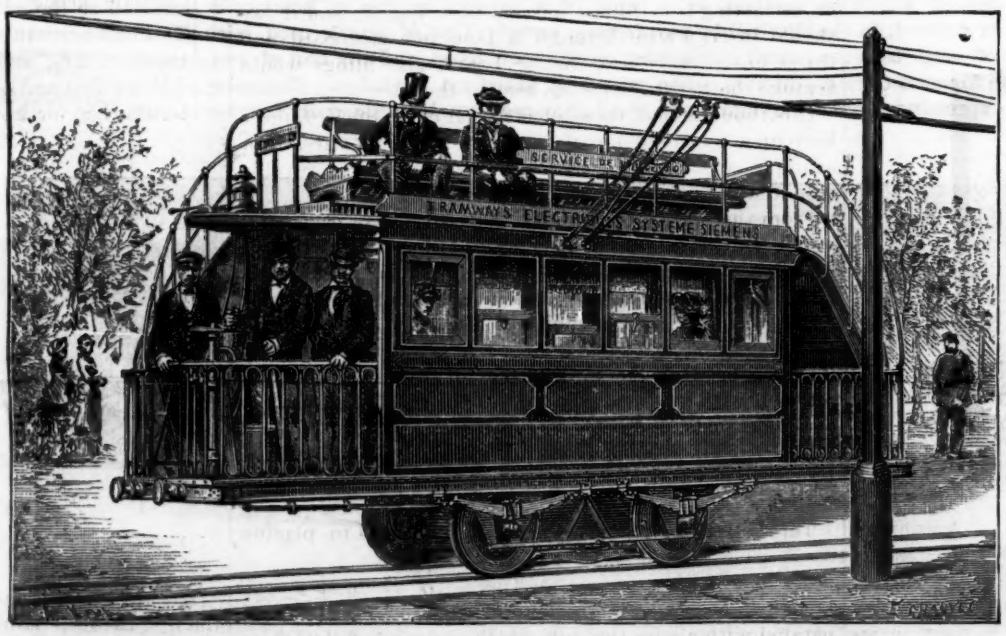
Overhead conductors, made of copper bars, wires or tubes are used. These can be insulated at least as perfectly as telegraph wires. Their construction, and the manner of conducting the currents to and from the motors used in connection with them, will be considered under the proper heading. The two illustrations we print to-day show cars run by currents derived from overhead lines in this manner.

Some experimenters have deceived themselves and others into building lines of considerable length without previously taking leakage into the account. If an experimental line of 500 feet in length be defectively insulated so that it leaks ten per centum, the loss would be ignored or not discovered under the "rule-of-thumb" experiments. But let the line be similarly extended to the length of a mile (a little more than ten times as long as before) and the leakage will be 10 × 10 or 100 per centum.

The loss of power, or of energy, through leakage, is in the proportion which the current so lost bears to the total current, or as $\frac{e}{C}$ or $\frac{R}{r}$; $R$ being the total resistance, and $r$ the resistance of the leaks.

The accompanying fine illustrations exhibit two views of the electric tram-car used during the Paris Electrical Exposition. This car carried 84,000 persons. The car carried the motor beneath it, instead of being drawn by a separate locomotive. The first cut shows the car just as it is about to turn the curve from the Champs-Élysées to the Palais de l'Industrie, where the Exposition was held. The second cut shows the other side of the same car for the purpose of illustrating the manner of taking the current from the conductors placed on poles and parallel with the line of track. The loops between the conductors and car are shown in the upper-front portion of the figure. We are indebted for the originals of these cuts to *La Lumière Electrique* and to *Du Moncel's Electricity as a Motive Power.*

(TO BE CONTINUED).




TRAM CAR AT PARIS ELECTRICAL EXPOSITION: MANNER OF TAKING CURRENT FROM CONDUCTORS.

### The Feasibility of Utilizing Niagara.

Mr. Benjamin Rhodes, at a recent meeting of the American Association of Civil Engineers, discussed as follows the greater utilization of Niagara:

Dynamic electricity is used substantially only for the electric light, but this use has become a great industry. It is the object of this paper to show what has been done and what may be done toward the utilization of Niagara for electrical purposes. The power of Niagara can be estimated very approximately. The average flow of the river according to the many careful measurements is 275,000 cubic feet per second. The fall in the river through the rapids immediately above the fall is sixty-five feet. The height of the falls is 165 feet, making a total of 230 feet; thus we have for the whole power 7,000,000 horse-power. To utilise this amount of power by water-wheels, generate electrical currents, and transmit to various cities within 500 miles would necessitate a plant representing at least $5,000,000,000. Such figures as these give some idea of the enormous amount of power here in reserve.

A small proportion of the power of Niagara is already utilized, and a much larger amount can be developed at moderate cost. On the Canada side the entire use is represented by a small overshot wheel under six feet head, which has for many years propelled a solid piston single acting pump, furnishing a meagre supply of water to the adjoining village. On the American side, along the rapids on Goat Island and the mainland, there are five separate raceways using from four to sixteen feet head, and developing in all 800 to 1,000 horse power, most of which is now in actual use. If the project for the appropriation of lands for a State reservation at Niagara is carried out, all these races will come within the fixed bounds of the park, and will, of course, be odious in the eyes of the commissioners and be swept away.

The greatest power now in use at Niagara, however, lies outside the proposed State Park. It is the Hydraulic Canal, and was constructed about 1855. It is cut through solid rock across the peninsula on which the village of Niagara Falls is built, taking the water from the extreme head of the rapids and discharging below the falls, giving opportunity to use the entire head of 230 feet. The canal is nearly one mile long, and was planned 100 feet wide and ten feet deep. It has been excavated but seventy feet, and half the distance is but thirty-five feet wide. It is at present partially filled with débris, being at certain points no more than five feet in depth. At the lower end is a basin nearly at right angles with the canal, which may be extended as needed along the river frontage belonging to the Hydraulic Power Company. The canal lay idle for a quarter of a century, and it remained for an enterprising citizen of Buffalo, Mr. J. F. Schoellkopf, possessed of large capital and zeal, to open this great power. At the time of his purchase—in 1878—there was only one water-wheel on the canal. There is now a large and increasing number of buildings for manufacturing purposes distributed along the high bank of the river, using an aggregate of nearly, or quite, 5,000 horse-power. The wheels in these buildings are set under heads of from fifty to 100 feet, and discharge the tail-water over the side of the precipice, the various streams falling over 100 feet to the river below. Some of these wheels are of large size when the head is considered, several being capable of giving 1,100 to 1,500 horse-power each. The last two years have seen great improvements in the making and setting of wheels, and the working of all the mills is now regular and continuous.

Further developments of power at Niagara may be made at little expense. The Hydraulic Canal can be deepened and widened, and wheels may be set under greater heads, the total amount thus made available here being equal to the necessities of many years. Large powers may also be developed at Goat Island and Prospect Park in case the State Park plan is not effected; in either place 10,000, 25,000 or even 50,000 horse-power being easily available. It may safely be said that the use of Niagara has just begun. Low water is unknown; troubles from ice are slight; hours of use are not limited to eight or ten, but twenty-four hours in the day and 365 days in the year, and unlimited power is ready, making this the most reliable, as it is the grandest, water-power in the world.

### Commercial Cable Progress.

The Faraday left the Thames on Monday with 5,000 tons of the Commercial Company's cable. She will proceed at once to Waterville Bay, on the Kerry coast of Ireland, and lay the shore end, or heavy type of cable, in the same manner as at Rockport, Mass. This work will probably be completed during the week, when the connection with the deep sea portion will be made and the course of the ship laid for the buoy which she left in mid-ocean a few weeks ago, and to which is attached the American half of the cable. The buoy will probably be reached by the 20th of July, when, by splicing the end attached to the buoy and that end on board the ship, the circuit will be completed between England and America, and, barring accident, the first of the two proposed Mackay-Bennett cables will be in working order.

The station at Waterville is well fitted with all known electrical improvements, and a staff of twenty persons, including electricians, operators and clerks, is ready for business as soon as the through connection is made. The cable will be duplexed, (carrying messages in opposite directions at the same time) by a novel method which experts say is an improvement on that already in use. All the apparatus necessary to do this work is on the ground and has been fully tested and approved. When the Faraday has made her final splice and the cable is pronounced in working order, Sir William Thomson will probably make an official test for insulation and capacity.

### Detecting Zinc and Lead in Presence of Iron.*

In a recent number of the *Comptes Rendus* M. A. Deros gives the following instructions for the detection and estimation of zinc or lead in the presence of iron, viz.: *Zinc.*—The hydrochloric acid solution of 1 gram of the substance is poured gradually, with agitation, into an excess of ammonia, and when cold the mixture is electrolysed in a platinum capsule which acts as the positive electrode, the negative electrode consisting of a platinum spatula or a coil of platinum wire. The current employed should give 300—400 c.c. of detonating gas per hour. Care must be taken to keep the liquid ammoniacal, and after three or four hours the negative electrode is withdrawn, carefully washed, and then treated with a few drops of dilute sulphuric acid, which dissolves the greyish deposit. The solution is evaporated to dryness in a platinum dish with addition of a few drops of cobalt solution and strongly heated; a green residue shows the presence of zinc. In order to estimate the zinc, the solution of 1 gram of the substance is treated as just described, the negative electrode consisting of a sheet of platinum 3 cm. broad and 4—5 cm. long. After 12 hours the zinc will be completely precipitated, which can be proved by placing a new electrode in the liquid. The negative electrode is rapidly washed by immersing it in water, care being taken not to detach any of the somewhat loosely adhering deposit, and is then immersed in a solution of potash or soda 8° or 10° B., which dissolves only the zinc. The alkaline solution is again electrolysed, the zinc being deposited as a firmly adherent crust on a weighed platinum cone. The deposit is washed successively with water, alcohol and ether, and dried at 90—100°. It is advisable to wash with water before interrupting the current. *Lead.*—1 gram of the finely powdered substance is placed in a conical flask with three or four grams of pure cadmium, and very gently warmed with dilute hydrochloric acid. When the solution is complete, and no bubbles of gas are given off from the cadmium, the lead is completely precipitated. The liquor is carefully decanted off, and the residue washed several times by decantation. Five or 6 c.c. of nitric acid are then added, and the solution of lead and cadmium is transferred to a crucible which acts as the negative electrode, the positive electrode being a weighed platinum cone. Rather less battery power is required than in the case of zinc, and in four or five hours the lead is completely precipitated on the positive electrode in the form of peroxide, which is washed with water, dried and weighed. This process will detect 0·0005 gram of lead in one gram of substance.

### Victims of Spurious Telegrams.

About fifty complaints have been received by the Western Union Telegraph Company from persons who have paid charges on spurious dispatches. The dispatches were written on regular receiving blanks, and were delivered by a messenger in uniform. The amount collected varied from seventy-five cents to $1.50. The persons swindled were, as a rule, well-known strangers stopping at the hotels, whose arrival had been reported in the newspapers. Milton H. Smith, of Louisville, received a dispatch saying, "Be ready to return home at once when you receive my letter. Something extraordinary has happened." Captain J. N. Miller, U. S. N., Assemblyman Curtis and R. T. Martin, received dispatches announcing that the senders would be in the city the next day.

All the dispatches were in the same handwriting, which is that of Charles F. Condon, aged seventeen years, of No. 1,127 Second avenue, a discharged messenger of the company. He has been arrested. He had in his pocket a slip of paper on which were written the names of Professor W. G. Sumner, Edward Atkinson, of Boston, and ex-Congressman John M. S. Williams, of Cambridge, Mass. It is said that other parties are concerned.

MADAGASCAR AS A MAGNET.—Hallez, a naval lieutenant, stationed at Madagascar, sends to the "International Society of Electricians" an account of the daily storms which rage there. The soil of the island is very ferruginous, and in approaching it the compass undergoes considerable and totally abnormal variations. Hence it is suggested that Madagascar may be an enormous magnet, to the French, at least.

* *Journal of the Chemical Society*, March, 1884.

## Electrical Information for Beginners.

BY WM. MAVER, JR.—PART VI.

*Electricity and Magnetism.*

In the last chapter we saw that a magnet would induce magnetism in a piece of iron even before the iron touched the magnet, and we also saw that a magnetic needle tended to point north and south.

Exactly what the nature of the force is that causes the magnetic needle to point north and south, and the iron to become magnetized on its approach to a magnet, is not known any more than what the force is that causes the unelectrified body to exhibit electrification on its approach to an electrified body.

Electrified or magnetized bodies do not give any visible evidence that there is any thing peculiar about them, until we take means to cause them to make manifest that there is.

It is difficult, however, to imagine that an effect can be produced without a cause or that action can take place at a distance. For instance, if we should see a bell swinging in a tower we would at once surmise that this action of the bell was caused by some one pulling the bell rope.

Or, if we should place a lighted lamp at a short distance from a metal reflector we would rightly assume when we had observed that the reflector had grown somewhat warm, that this effect had been produced by the lamp by means of the radiation of its heat, through the intervening air.

Likewise, when we observe that by placing a piece of iron near a magnet, the iron becomes magnetized, and that an unelectrified object becomes electrified when placed close to an electrified body, it is natural to theorize that an action of some kind is taking place through the air or other substance, which intervenes between the cause and the object acted upon.

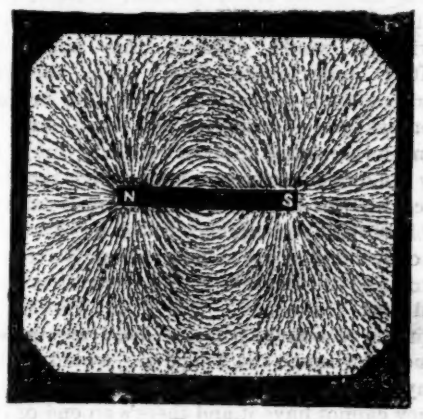



FIG. 15.

And, in the case of a magnet, this theory is borne out, in a measure at least, by the fact, that when we place a magnet beneath a piece of glass or cardboard, and on this glass or cardboard throw some iron filings and then gently tap the supporting substance, the filings will place themselves in regular curved lines from one pole to the other, as seen in Fig. 15, which would seem to indicate that the air, or the ether of space, was made a medium for this magnetic effect, in a manner analagous to that in which it served above, or was the means by which the heat was conveyed from the lamp to the reflector, and that the magnetic effect was continuous through the air from pole to pole of the magnet.

This phenomenon was discovered by Faraday and was termed by him "lines of force."

The term "lines of force," although a very convenient term to use, should not, however, be allowed to convey the impression that these *lines* are absolute and real. It would, perhaps, be better to imagine the above effect as produced by a magnetic mass of force exerted between the two poles. This latter idea is sustained by the fact that if we remove the card and redistribute the iron filings, and again place the card in exactly the same position over the magnet as before, the lines will not invariably resume the same positions on the card-board, as it is likely they should have done had the force actually been exerted in uniform lines.

It is supposed that the action of the iron filings in placing themselves as above is as follows: The particles of the air, or of the ether (which it is supposed permeates all space and substances) between the poles of a magnet, become magnetized, and in consequence they place themselves, as an ordinary magnet will, when in proximity to another magnet, for instance with a north pole pointing to the south pole of the next particle, thereby, as it were, forming a chain between the two poles of the magnet. Thus when we place iron filings within the magnetized space, they also become magnets, each particle of the filings having a north and south pole, and the south pole of one particle pointing to the north pole of an adjoining particle, etc.

I say it is supposed that the above action takes place, because the exact nature of the action has not yet been discovered and consequently any explanation of it can only be suppositious. The theory that meets the most requirements in such cases is the one that should be adopted.

These lines of force are supposed to travel from the north-seeking to the south-seeking pole.

In order the better to explain all the effects produced by these so-called lines of force, Faraday conceived that they had always a tendency to shorten themselves, in the same manner, perhaps, as though we should suppose that each of those curved lines might be ropes, on wetting which, or if they should be pulled at either end, they would naturally, by becoming straight, grow shorter.

This action of a magnet will occur no matter what we interpose between its poles, excepting iron. Glass, brass, copper, wax, resin etc., may be placed between the poles of the magnet without at all disturbing the arrangement of the iron filings on the cardboard. If, however, a bar of iron be placed between the poles it appears to concentrate the lines of force and they apparently pass from pole to pole through the iron as shown in Fig. 16, where it is seen that the curves have almost disappeared. At the same time the interposed iron itself has become a magnet.

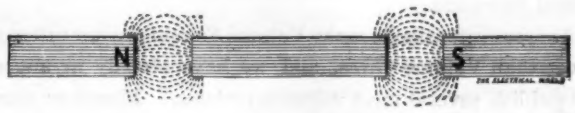



FIG. 16.

If we place the unlike poles of a magnet opposite each other, it will be found that the lines run out from each pole a certain distance and then curve away from each other showing a repulsion. This is seen in Fig. 17.

No such magnetic effect, however, is seen when we try the same experiment, namely with the iron filings, with a statically electrified body, that is, a body charged with static electricity, or electricity at rest. When, however, we send a *current* of electricity through a conducting body, for example an iron or copper wire, we find that the wire has now the same power of attracting iron filings as a magnet, Fig. 18, and if we should insert a wire through a hole in a cardboard and throw filings, as before, on the board, the filings would arrange themselves in circles around the wire.

It is thought that these electro-magnetic lines of force keep up a continual circulation around such a wire. For example, as though many rings were caused to revolve around a wire or stick.

From this fact it is assumed that the air or ether surrounding conductors through which there is a current of electricity passing, assumes the same condition as the air or ether in the presence of a magnet, and this assumption is well sustained by many proofs.

For, example, it is well known that a magnetic needle, if placed between the unlike poles of two magnets, will set itself with its north pole toward the south pole of one of the magnets, and with its south pole toward the north pole of the other magnet. In technical language, it thus places itself parallel to the "lines of force" of these other magnets.

This action of a magnetic needle with regard to placing itself, when free to move, parallel to the lines of force of other magnets is unvarying. Therefore, when, as is well known to be the case, a magnetic needle places itself, not parallel with a wire through which a current of electricity is flowing, but at right angles to it, that is across the wire, it is natural to infer that it is placing itself parallel to the magnetic lines of force, which, it has been shown by the experiment described above, encircle such a wire.

The same thing occurs or is supposed to occur when a magnetic needle points to the north and south magnetic poles of the earth—that is—it places itself parallel to the magnetic lines of force of the earth's magnetic poles. For it is further supposed, and with very good reason, that lines of force extend from the north magnetic pole to the south magnetic pole of the earth, and this explains why a magnetic needle points north and south—and it also serves to explain why the needle of a galvanometer places itself at right angles to a wire through which a current of electricity is passing, namely, the magnetic lines of force of the needle

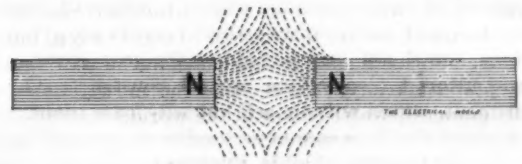



FIG. 17.

endeavor to place themselves parallel to the magnetic circles generated around the wire, and in doing so, carry the needle with them. If the coil were movable and the needle stationary, the coil would place itself at right angles to the needle, owing to precisely the same cause. One very interesting experiment which goes to support the foregoing theory is the following. We have already seen that when we pass a coil of wire before the poles of a magnet a current of electricity is developed in the coil. In other words when we cause a coil of wire to *cut* the lines of force of a magnet we generate a current of electricity in the coil, that is to say, we set up circular magnetic lines of force around the wire of the coil. Now if we prepare a few coils of copper wire, having, say a diameter of one foot, and make the coil a portion of a circuit which includes a delicate galvanometer, such as Thomson's reflecting galvanometer, we shall find that if we give the coil a rapid motion in such a direction that it will *cut* the earth's lines of force, the needle of the galvanometer will be deflected, precisely as when we moved the coil before the poles of a magnet.

These magnetic circles, or whirls, apparently vary in direction around the wire with the direction of the current through the wire, and as the circles vary in response to the changes of the direction of the current, so does the magnetic needle change its position according to the direction in which the magnetic circles are revolving. Further, these circles evidently increase and expand or diminish and contract with the strength of current which is traversing the wire.

That these circles gradually diminish in strength as they recede from their centre (the wire) is by experiment well known. It would be very interesting to know just how far these magnetic circles, when not intercepted, extend from the wire.

The discovery of this action of a magnetic needle with relation to a wire carrying an electric current gave rise to a new theory, and not an unnatural one, perhaps, in explanation of the reason why a magnet points uniformly north and south.

The theory was this, that the rotation of the earth upon its axis, by constantly presenting a new portion of its surface to the sun, caused one portion to become heated and allowed another portion to cool, this action having a tendency, through some thermo-electric effect upon the minerals of the earth, of generating currents of electricity around the earth, in an easterly and westerly direction.

If this were the case, it is argued, the magnetic effect on the surface of the earth, following out the analogy of the effect of a current upon a wire, would be such as to induce magnetic lines of force in a north and south direction, that is, at right angles to the supposed direction of these electric currents in the earth, and, consequently, a magnetic needle in placing itself, as usual, parallel

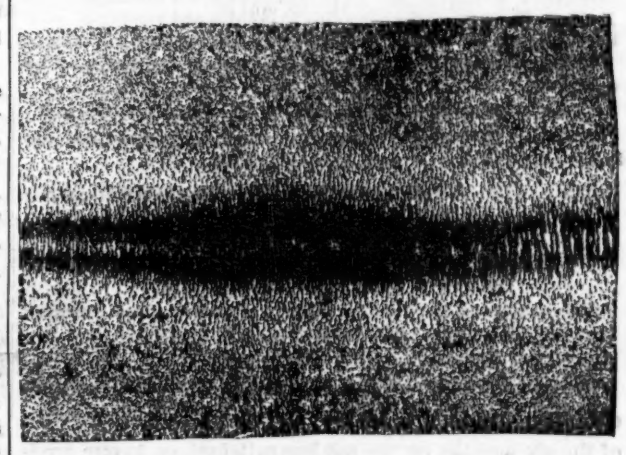


FIG. 18.

to the magnetic lines of force must necessarily point north and south.

The burden of proof, however, would tend to show that the first theory, namely, of two actual magnetic poles of the earth, is correct. These magnetic poles of the earth are not situated exactly at the geographical north and south poles. The magnetic north pole of the earth is over 1,000 miles northwest of the earth's north pole, just within the Arctic circle.

At the magnetic north pole a dipping magnetic needle points directly up and down—the north-seeking pole down, the south-seeking pole up. As we progress from the pole this needle gradually tends to assume a horizontal position until, in the vicinity of the equator, it reaches that position. As we go farther south the south-seeking pole now points downward, and its downward tendency constantly increases as the south magnetic pole is approached. The exact location of the latter pole has never been definitely ascertained.

(TO BE CONTINUED.)

## Telephone Interests in Canada.

The paid up capital of the Bell Telephone Company of Canada is one million dollars, says the *Canadian Electrical News*. Assets about one million two hundred thousand dollars. The company is paying 7 per cent. dividend to its shareholders.

| | |
|---|---|
| The net revenue for 1882 was | $69,590 15 |
| " " " 1883 " | 112,233 50 |
| Showing an increase | $42,643 35 |

The Bell Telephone Company of Canada offers for sale $100,000 six per cent. ten year first mortgage bonds at 93 and accrued interest from 1st April, 1884, which price will pay the purchaser 7 per cent. per annum interest, payable half-yearly on 1st October and 1st April.

These bonds are in denominations of $1,000, $500, $250 and $100, and form part of an issue authorized by act of Parliament, which is a first lien upon all the lines, works and plant of the company.

DECISION AGAINST A CABLE COMPANY.—The following dispatch of June 25 has been received from London: "In the case of Muirhead against the Direct Cable Company, it was shown that the defendant had agreed to pay £2,000 yearly for the use of a duplex system, but that the cables had been faulty since 1882 and it had been impossible to employ the system. The court decided that the cable company was bound to repair the cable or pay under the agreement.

THE
# ELECTRICAL WORLD,
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## THE END OF OUR THIRD VOLUME.

The present number brings to a close the third volume of THE ELECTRICAL WORLD. We think that the retrospect of the six months proves not less satisfactory to our readers than it is to ourselves. During that period the paper has advanced in every respect. It has contained more original matter, more illustrations, and more advertisements than ever before, and has reached a larger public. It has been a complete and trustworthy record of all that has been done of importance in electrical science and art since the beginning of 1884.

Few journals of any description are so profusely illustrated as THE ELECTRICAL WORLD. In our last twenty-six issues we have given nearly 400 engravings. Of these over 70 belonged to our patent record, in which we describe all electrical patents issued in this country, and a majority of the others related to new inventions and applications, the scientific description of which appeared first in our columns.

A glance through the third volume shows that the paper has, as heretofore, covered the whole field, and has been without compeer. In telegraphy we have illustrated and described the latest developments in automatic fast-speed telegraphy, ocean telegraphy and cable construction; in telephony, the Gillett long-distance telephone, the Drawbaugh instruments, the Van Ryssel-berghe system and the Stabler individual call; in electric lighting, the Excelsior system, the Pilsen and the Benrstein lamps, the Ganz, Edwards and Colburn dynamos, the Ide, Ball and Harmon-Gibbs steam engines, and special applications of the light in theatres and afloat. Besides these, we have published with thirty-two cuts, nearly all drawn specially by the author, Dr. N. S. Keith's lecture on electric lamps and regulators. Under the head of miscellaneous we may include our copious articles, with views, maps and plans, on the International Electrical Exhibition, to be held at Philadelphia; the illustrated description of telpherage; Prof. Brackett's dynamometer, and the first four of a series of illustrated articles on the interesting subject of electric railways.

Beyond all this, we have published the latest researches of Prof. Hughes in magnetism, and for the benefit of new comers in the electrical field have, with great satisfaction to the large class for which they were intended, published with numerous illustrations, "Electrical Information for Beginners," by Mr. Wm. Maver, Jr., electrician of the Baltimore & Ohio Company, and "How to Construct a Galvanometer," by Mr. Thomas R. Taltavall, of the Associated Press. Mr. Maver has also contributed special illustrated articles on the principles of ocean telegraphy; and from Mr. P. Atkinson, A. M., we have had an article with three large cuts, on his four-plate Töpler machine.

Our editorial and news columns have gathered up and explained all that was new and momentous on the underground wire question, the telegraph consolidations, and the new cables. The Reis-Bell controversy has made the department of correspondence lively, and our reviews of new books have included all the latest contributions to electrical literature.

It is our intention to make Volume Four of greater interest even than Volume Three, and we have already arranged to publish several most valuable articles. Moreover, during the next six months, the Philadelphia Exhibition will be held, and we shall do all in our power to treat it as its importance demands. No one interested in electrical matters can afford to be without THE ELECTRICAL WORLD at such a time, and we take this opportunity of pointing out that the subscription to the paper for the remainder of the year is only $1. What we furnish in return for that small sum can be seen from the last volume. We shall be obliged to any of our readers who will send us the names of new subscribers, or who will bring the paper under the notice of any of their friends having any interest in electricity, scientifically or commercially.

As almost all our readers preserve the paper for reference, we have had made excellent binders of handsome appearance, that we will mail to them, prepaid, for $1.50. Any back numbers wanted to complete files should be applied for at once.

## TELEPHONE RESTRICTIONS IN GREAT BRITAIN.

Patience is an estimable virtue, but an exhibition of the opposite quality becomes highly meritorious sometimes, and we are glad to observe that the dog-in-the-manger policy pursued by the English Government with regard to the telephone is provoking business men who suffer from it to the expression of great impatience and annoyance. The Edinburgh Chamber of Commerce and Manufactures, not without precedent, however, has just addressed to the Postmaster-General a memorial on the question of telephone facilities, urging the Government to grant such concessions and make such changes as will encourage the wider adoption of the telephone system.

So persistently obstructive hitherto, have been the officials in charge of the telephone service, that it looks to us very much as though the Edinburgh Chamber will find itself in the position of Oliver Twist when he had the audacity to ask for "more." It is stated that in every case where a Government Telephone Exchange has been established in England, with the single exception of Newcastle on-Tyne, it has been a total failure. And yet, having shown that it cannot work the service itself, the department throws all manner of obstacles in the way of licensed companies. We hear now and then that the Bell Company here are greedy and make very close bargains with their licensees, but it seems to us that their terms are generosity itself compared with the exactions of the English Post-office. The wonder is that the exchanges conducted by private enterprise succeed so well. The department demands first its 10 per cent. on gross earnings. It limits the operations of each exchange within a radius of three or four miles, and when "ultra-radial" licenses are given, 2½ per cent. additional must be paid on the gross rentals. The extra-territorial connections are all constructed by the department, which will not sell but only lease them. Even when leased the lines cannot be used by the general public, and no press business at all is allowed to pass over them. All the companies are anxious to establish pay-stations, but their applications have been systematically refused. No companies can obtain a license unless they agree to furnish the department with an unlimited supply of instruments at very low prices fixed by itself. Other vexations and restrictions of all kinds hamper the business, and we mentioned recently how with Shylockian eagerness the department sought to tax the very advertisements put by the companies in the directories that they had printed at their own cost.

It is very hard to understand why all this should be, harder to understand how an intelligent, independent public can submit to it The plea that the ten million pounds sterling invested by the country in telegraphs must be protected is weak, and it is but an evidence of the awkward position in which a government is placed with regard to new inventions when it has spent money on old ones. We can only hope that the important towns and cities in Great Britain now asking for a telephone service, but unable to accept the terms imposed by the authorities, will by joint action and a healthy public agitation of the matter be able to obtain more favorable conditions.

## THE NEW UNDERGROUND LAW.

The news in regard to the enforcement of the Daly law in New York and Brooklyn will be found elsewhere in our columns. It would appear that Superintendent Walling's action, in this city, is a little premature, as we learn that the Corporation Counsel has not yet expressed an opinion as to the requirements of the law. The Baltimore & Ohio Telegraph Company filed a petition on Wednesday with the Police Commissioners of this city, setting forth that the company has only a few more wires to string in order to complete its circuit to Boston; that the completion of this circuit would be of material benefit to the general public, as it would reduce the excessive tariff now charged by the Western Union Company for messages to Boston, and that a suit is now pending in the Supreme Court to test the constitutionality of the Daly law. In view of these facts, the petition asked that the arrest of workmen on the extension of the Baltimore & Ohio line to Boston be discontinued until the determination of the suit. The Commissioners entertained the petition and agreed to suspend proceedings until the suit is determined.

The various companies are prepared to protect their interests, but do not evince an inclination to do much else. The Metropolitan Telephone Company will, we hear, utilize dead wires for new services, wherever possible, and when applications are sent in for services that cannot be supplied, it will decline to make a contract, giving its reasons for refusing business. It will be interesting to see how long the public will stand that sort of thing. Probably the company can stand it longest, or until its customers whose representatives have helped to embarrass it come to its relief by calling for a law of more practicability. As the Brooklyn *Eagle* remarks in an able and temperate article: "It almost seems like class legislation to order the telephone under ground, though, no doubt, those who voted for the present bill believed that its provisions would advance the public convenience. It is unfortunate that, when the storm of public indignation is passed and corrective or restrictive legislation has been adminstered as a salve, only those of slender means are found to have been left out in the rain. You may build expensive subways through the streets and thus force up the already high telephone rates fifty per cent. It is of little consequence to the wealthy. The telephone is convenient, saves so many steps, is so trustworthy when compared to the average messenger that it will be employed just the same. But it is different with the general public who must perforce look to the cost. It matters not how much the telephone would assist them, how many steps it would save them, if it is beyond their means they cannot have it and there's an end of it." This is the view that some of the other papers once so vehement in behalf of underground wires are beginning to take, and it applies as much to other electrical transmission as to telephony.

The upshot of all the agitation will probably be that a great many more trunk lines will be buried by and by, that many telephones will be worked on circuits with individual calls, and that a great many wires will be taken off the poles and grouped on the housetops. Until a comprehensive and permanent plan is adopted by the State or the two cities in conjunction with the companies, very little will be done in any direction. Mr. Edison, however, is bringing out an infallible leaden tube system, and that may perchance expedite matters.

## THE PROTECTION OF OIL TANKS FROM LIGHTNING.

The return of summer has been signalized in the usual way where oil is stored. Hardly a thunderstorm occurs in the vicinity of oil tanks without causing a serious fire; and already at Cleveland and at Point Breeze, Philadelphia, tremendous fires have been the result of lightning strokes. As we write, news comes of another heavy thunderstorm at Pittsburgh, during which several oil tanks, containing thousands of barrels of oil, were struck and then burst into flames.

These fires are serious. The Point Breeze refinery was in flames for four days, during which time twenty large tanks and many buildings, as well as much valuable machinery, were destroyed. It is time some sure preventive was found, but so far nothing effectual has been presented. We notice that in the last number of the Chicago *Industrial World*, Mr. Oberlin Smith takes up the subject as one of the most important now pressing for consideration. Accepting the theory that the vaporization of the oil creates a lofty column that acts as a kind of lightning rod, he contends that the way to meet the difficulty is to run a rod or metallic conductor high enough to overtop the inflammable column of vapor, with branches extending laterally to protect against lower clouds that might discharge their lightning in a partially lateral direction. It is said that the lightning at Point Breeze caused an explosion in the air at a height estimated to have been from 100 to 300 feet. Mr. Smith says: "I do not know whether any experiments have been made with regard to the height and inflammability of these vapor columns; undoubtedly there is a height where the gas is so diluted by air as not to be combustible. Guessing at the subject, it would seem as if a rod extending three or four hundred feet high might protect a considerable area of oil-yard. A friend at my

elbow suggests a construction something like the electric-light towers used by some of the lighting companies. The expense of this would not be worth consideration compared with the loss sometimes occasioned by one stroke of lightning, and such a tower might be utilized for lighting the oil-works by arc lights in the usual manner. At the top of the tower, a rod cheaply made of gradually reducing gas-pipes could be extended a good many feet above the summit, to still further lessen the danger. Of course such a tower should have ample metallic connections with an extensive system of underground water-pipes, and all joints should be made with as perfect contact as possible."

We think that the subject is one to which scientific and others interested might well give their earnest attention.

## "PRAISE FROM SIR HUBERT."

In delivering his address this month before the Gas Institute, of England, Mr. Robert Harris, the president, took occasion to make reference to the electric light. Speaking, like M. Olivier, when France went forth to fight Germany, with "a light heart," he expressed his belief that electric lighting has now assumed a position of very minor as far as the gas industry is concerned. "It has been proved, and judging by the results as shown in the defunct and moribund companies, proved over and over again, it cannot compete with gas, as now very generally used at the prices that rule in England." Mr. Harris may find that the inference or deduction is a hasty one, and that the death of these speculative enterprises will be the best stimulus that could be got to economical and profitable electric lighting. The new means of illumination is passing out of the "wonder" stage when fools can be gulled by sharps, and it has already taken its place as a growing, legitimate, money-making business.

But Mr. Harris himself takes back his own words by adding: "We must not ignore the fact that there is a source of artificial illumination other than the one in which we are more directly interested, which may come into competition with us, and which doubtless will find its position alongside gas in certain places where its peculiar qualities render it more suitable." He instances ocean steamers, and admits that he is informed that several large ships are now lighted with incandescent lamps. He need not have stopped short there, however, as more information of the same kind is easily obtainable.

## Lighthouse Tests in England.

Elaborate experiments are being made at the South Foreland Lighthouse, on the coast of Kent, to ascertain the relative capabilities of electricity, gas and oil for lighthouse purposes. The Corporation of the Trinity House is acting in conjunction with the Scotch and Irish Lighthouse Boards, and the representatives of various foreign Governments are taking an active interest in the experiments. The South Foreland Lighthouses have been lighted by arc lamps since 1857, the current being supplied by four Holmes magneto machines (the E.M.F. of which does not exceed 60 volts), driven by a 10 horse-power nominal steam-engine, by Hunter and English, another similar engine being kept in reserve. In connection with the present experiments three temporary wooden towers have been constructed in a line landwards, and bearing northwest from the permanent high light. These towers are marked A, B and C, and are respectively used for the electric, the gas and the oil light. Tower A is 245 feet from the high light, and tower B 180 feet from A, tower C being the same distance from B. The focal plane of all the towers is 15 feet below that of the electric high light, which is 380 feet above sea level. In the electric arrangements Baron de Meritens' arc lamps and magneto-electric machines are employed. At present there are two of these lamps and two of the machines in place, but another of each is to be added. The lamps are placed one above the other, or superposed, in the tower. The carbons used in them are compound—that is, they are made up of a number of small carbon rods of square section. These carbons in use were until recently 1½ in. square, and were composed of 49 small square rods, but since then the new Berlin cored carbons of Messrs. Siemens have been employed. The two machines for producing the current are placed in the engine-house with the others, and are driven by the same engine as the Holmes machines. Each of the De Meritens machines is arranged for working at 1-5th, 2-5ths, 3-5ths, and at full power, the estimated intensity of the light from each machine at those powers being respectively 6,000. 12,000, 18,000, and 30,000 candles. The machines can either be worked singly or coupled up. Like the Holmes machines, those of De Meritens produce a low tension current, and are found to be very reliable in operation and inexpensive in maintenance. The arrangements for illuminating tower B consist of a small gasworks erected by Mr. J. R. Wigham, of Dublin, whose burners are used in the tower, his system having been adopted for lighthouses on the Irish coast. The gas-producing apparatus consists of a small retort house fitted with two benches of three retorts, the necessary purifiers, and a holder capable of containing 4,500 cubic feet of gas. The gas is passed through a meter placed outside the tower to the burners within it, which are four in number. Each burner is composed of a series of concentric rings of jets, and the light can be started with a *minimum* power of 28 jets, and increased by gradations of 20 jets up to 108 jets, the full power of each burner, at which it develops 3,000 candle-power. There are four of these burners superposed, and they can be used either singly or together. In tower C oil lights are used, and these are produced by means of burners of the recognised Trinity House pattern. The burners at present in use have six concentric wicks, each burner developing 720 candle-power; but Sir James Douglass is preparing another burner of much higher power, having seven wicks, which will shortly be tried. The burners are arranged in three stages, and either a uniform, a biform, or a triform light can be exhibited as required. The burners are in duplicate on each stage, and by an ingenious arrangement the first lamp can be shunted out of position if necessary, and the second one lighted and shunted into its place without any appreciable loss of time. Such are the arrangements for producing the various lights. For testing them carefully elaborated arrangements have been made. An overland route has been laid down as a line of observation for a distance of 2½ miles from the towers in the direction of Deal, and stakes have been driven at every 100 feet. At half a mile from the towers on this route is hut No. 1 for taking photometric observations, and this is more particularly intended for fog work. At 1¼ miles is hut No. 2, which is likewise fitted with photometric apparatus. At the limit of the range is a third hut, each hut being conveniently fitted up for the residence of the official in charge. Upon the occasion of a recent visit splendid lights of varying intensities were produced at night by each of the three systems under trial. The preliminary photometric observations appear to indicate that the electric light in comparison with either the gas or the oil light is as the sun is to a candle.

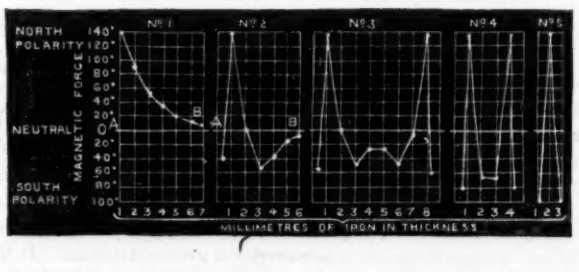
## Magnetic Polarity and Neutrality.

BY PROF. D. E. HUGHES, F.R.S.

(*Continued from page* 190.)

The curves obtained by the various methods are so numerous, each requiring more space than the limits of this paper will allow, that I am forced to give roughly the general outlines, as in Fig. 1. Suppose we take a compound bar of iron of eleven strips, and draw it over a permanent magnet, polarizing its lower side only, its neutrality may be found nearly perfect, or 15° of remaining north polarity at the north end; now, on carefully separating these rods and observing the same ends, we have for the lower or the side which had been magnetized, 350° north; the following successively observed would give 10° south, 35° S., 55° S., 60° S., 50° S., 40° S., 22° S., 10° S., 6° S., 5° S.; here all the superposed bars are opposite in polarity to the exterior 350° north, the total south observed being 292, plus 30° south obtained from the exterior, by the coating of its lower face with the $\frac{1}{16}$ milim. of iron strip already mentioned. We are thus enabled to account for 233° south, and 350° north, leaving a remaining magnetism unaccounted for of 12°, which was doubtless disseminated on the surface of each bar on separation.

The above curves were obtained from the same polar (north) end of a compound bar of iron; the south or opposite end of the bar would give reversed curves to these. The curves are reductions to a similar force, but do


NORTH POLARITY
NEUTRALIC
SOUTH POLARITY
MAGNETIC FORCE
140° 120° 100° 80° 60° 40° 20° 0 20° 40° 60° 80° 100°
No 1
No 2
No 3
No 4
No 5
A
B
1 2 3 4 5 6 7 1 2 3 4 5 6 1 2 3 4 5 6 7 8 1 2 3 4 1 2 3
MILLIMETRES OF IRON IN THICKNESS

not exhibit the perfection of the curves obtained on a larger scale.

No. 1 represents the typical curve of penetration of a bar of iron, while under the influence of an exterior polarizing force, applied at *A*, or only at one side of a bar. When the force is applied to the whole of the exterior surface (as in a coil), *A* would represent the polar force on its surface, while *B* the interior. In all cases there would be a depression at the centre; great if the bar is thick, and comparatively small if the bar is thin. The curve rises with the exterior polarization force, but in no case can a reversal ensue while under its influence. The instant, however, that it ceases, the higher magnetic power of the exterior layers reacts gradually and successively upon the weaker interior layers, rotating them through neutrality to a strong opposite polarity.

This is seen in No. 2, which represents exactly what takes place in No. 1 upon the cessation of the inducing influence. We notice that the first portion of the exterior has rotated to south polarity, followed by an intense north, but not of great density; its reaction, being more violent, rapidly rotates all the interior to a south polarity, gradually weakening in intensity as the distance increases from the inducing north polarity. The exterior, in fact, reacts upon its interior precisely as before the inducing exterior magnet reacted upon the whole. In No. 1 the south pole of the permanent magnet produced a continuous curve of north the instant this ceased the north of the exterior produced an interior south, and if these are perfectly balanced, then and then only will the bar become neutral.

When both sides of the bar are polarized at the same time then we have two similar curves to No. 2, as shown at No. 3, the diminishing curves of internal opposing polarity overlapping each other; the curve represents those obtained on bars 2 centims. in thickness. If the inducing force is great, the penetration is greater and more intense, reacting more violently, and the central depression of the opposing waves is less pronounced. If we keep the previous force and diminish the thickness of the bar the two central waves cross each other, and at last, as in No. 4, we have only one wave; this occurs with bars of but 3 millims. thickness. We notice here that from a want of sufficient material in the centre of the iron it is constrained to force its central wave to a far higher degree, and that the exterior now also commences to be reacted upon more violently. Evidently the conditions are strained, and we shall see the result later. This want of sufficient material to form the internal opposing wave of polarity is shown when we reduce the thickness of the bar to 1 millim., the width being 3 centims., and the length 30 or more, as in all previous cases. Here there are no traces of an internal curve, the opposing polarity as shown in No. 5, being entirely on the surface.

I have shown that we may clearly perceive this curve by dissolving its exterior in dilute nitric acid, but as I employed vibrations to reduce it to neutrality, this might give rise to objections on the score of mechanical reactions. To meet this objection several strips of magnetized steel of various forms, but all ½ millim. in thickness, were reduced almost to neutrality by simply heating them to a dull red heat, allowing them to cool slowly. These gave remarkable results, proving that the vibrations caused by heat are similar in results to mechanical vibrations, and I found that in most cases their external evident magnetism was increased 100 per cent. by an immersion of fifteen minutes, and 600 per cent in one hour.

Interesting results can be obtained by this method, but if rapidity of chemical action is desired we must first remove the scale or oxide on the exterior by polishing with emery paper, or dissolve this first in acidulated bichromate of potass.

A perfect curve of these opposing polarities can be obtained by placing a glass vessel containing the steel and solvent in the balance itself, taking continual observations during its solution, and we may thus observe the gradual rise in force to a maximum, then its fall to zero, to an opposing polarity, completely verifying all previous observations.

Supposing the magnetized steel previous to heating gave 200°, we should reduce it to 50° if heated to dull red, a bright red heat would probably reduce it to 20°; we should then start from an almost perfect neutrality to find, on dissolving its exterior (and allowing for the reversed polarity of the reversed portion), all its previous polarity.

(*To be continued.*)

## The First Commercial Cable.

The London dispatch announcing that the Faraday has now sailed to lay the shore end of the Commercial cable holds out the promise that the new Atlantic cable will be in operation by the end of July. From the American coast the cable has been already laid over nine hundred miles toward mid-ocean. The season on the northern part of the Atlantic is now, remarks the *Herald*, becoming comparatively tranquil, so that the work of laying down the remainder of the deep sea cable will probably be easily and rapidly accomplished. The central part of the main North Atlantic basin is occupied by an irregularly shaped plateau, commencing far to the southwest of the Azores, in the so-called "Dolphin Rise," and culminating in the Azores. Deep sea soundings show that the northern extension of this rather sinuous ridge narrows "into a sort of isthmus," as Dr. Carpenter puts it, and it is over this submarine isthmus and along the valleys on either side of it that the telegraph cables between Ireland and Newfoundland were laid. Late researches have brought to light the existence of elevations from 49 degrees 20 minutes to 50 degrees north latitude and from 28 degrees 30 minutes to 30 degrees 15 minutes west longitude, known as the "Faraday Hills." As over all this elevated sea floor in the Central Atlantic, and on much of the area between it and the Irish coast, the water is comparatively shallow (the depths on the plateau varying from one thousand to two thousand fathoms), it has been thought to be peculiarly fitted for the reception of telegraph cables. Experience has proved that some kinds of sea bottom and some deep sea tracts afford greater security to cables than others. Fortunately for the new cable the "Faraday's" officers will have the latest and most exact information obtained by the soundings of the Siemens brothers, and can deposit it in the most eligible portions of the Atlantic bed.

NAVY DEPARTMENT INVESTIGATION.—An investigation is ordered into the alleged frauds in the U. S. Navy Department. One set of frauds involves an amount of $6,000, a considerable part of which has been obtained upon fraudulent bills for galvanic batteries and other scientific instruments, and appliances supposed to have been furnished for the medical branch to be sed on ships and stations.

## Randall's Rejoinder For Reis.

*To the Editor of The Electrical World:*

SIR: Permit me, through your columns, to thank Mr. Berliner for his effort to "put me right."

I am unfortunatly so stupid, however, that I cannot understand his hair-splitting arguments, and am still in the "wilderness," and need more assistance.

Mr. Berliner, in his reply to my article states: "It follows that the transmission of the spoken word was aimed at, but not that it was achieved."

Now every one "skilled in the art," knows that the Reis apparatus, pure and simple, will transmit and reproduce words, and in order for Bourseul to prove priority to Reis, his apparatus must be capable of doing what it aimed at—transmit the spoken word.

I have understood that Bourseul had an *idea*, and I understand that the "Bourseul document" states the Bourseul *idea*, or invention, if you please, to "*concern* nothing more or less," etc.: but accepting Mr. Berliner's argument or opinion, as expressed in your issue of June 7th, that Bourseul invented *something*, a "Musical Telephone," if you please (*and did not know it*), I desired to know, and still desire to know, *what it was*, and how it operated, and *if* on this evidence it was "exit Reis," why it was not also "exit Bell"?

Will Mr. Berliner please reply again, or shall we accept his last explanation, that "the transmission of the spoken word was *aimed* at" but *not achieved*, and that therefore it *was not* "Exit Reis"?

To Mr. Berliner's query as to the supposable invention of a "telectroscope," I reply that under the Patent Office practice and the ruling of the courts, I should be *obliged* to "*consent* to see Mr. Selencq put up as prior inventor" if his invention accomplished the object aimed at, no matter how imperfectly, although his invention would not, or should not, deprive me of my rights in the *simpler apparatus*, or my rights *to what I invented*.

Mr. Berliner states: "It is to be regretted that Mr. Bell did not adopt an entirely different name for the system embodying the continuous and speaking current." Mr. Berliner must have forgotten that Prof. Bell's patent calls for an "Improvement in Telegraphy," while Prof. Reis' invention was called "The Telephone." Besides, does the change of the title to an invention make it another invention?" Would "a rose by any other name" become a lily (Jersey)?

Does Mr. Berliner set up Professor Bell's invention to be, "the system embodying the continuous and speaking current?"

Does this refer to a simple or compound current, *i.e.*, are there two distinct currents used, a continuous current and a speaking current, or simply "a continuous and speaking current?"

I am "splitting hairs" now, but I want to be positive, and have this clearly defined.

Is this the "cardinal point" in telephony that "M. Bourseul failed on?"

Will Mr. Berliner kindly answer these questions?

It is time this much discussed question was understood, and if Mr. Berliner will enlighten us all, and get us out of the "wilderness," *his* "monument" should be as high as possible and erected *at once*.

CHARLES A. RANDALL.

NEW YORK CITY, June 23, 1884.

## Enforcing the New Underground Law.

Superintendent of Police Walling sent out a general alarm last Saturday calling the attention of the police to the law now in force, which provides that all telegraph, telephone and electric light wires hereafter constructed in this city shall be placed underground. He said that the law was not intended to prevent the repairing of wires already in use, but the police will arrest all persons who try to erect new lines on poles or house-tops. A large number of telegraph poles, Mr. Walling said, had been erected recently in the upper part of the city, and cross-arms had been placed on them to receive electric light or telegraph wires. "The law," he continued, "does not prevent the companies from putting up as many poles as they like, or from nailing cross-arms on the poles, but we shall prevent them from stringing any wires above ground and the poles will be of no use."

On Saturday some new United States Electric Lighting Company's wires were strung along Broadway, on handsome new poles, of the Venetian mast type, with wonderful celerity. The first arrests under the new law prohibiting the erection of new lines of telegraph above ground were made on Monday, 23d. John O'Brien, Henry P. Hastings and Richard O'Donnell, linemen in the employ of the Postal Telegraph and Cable Company, were taken before Justice Gorman, in the Essex Market Police Court, for stretching wires upon new poles in Ludlow street and Avenue A. The prisoners claimed that they were merely transferring lines belonging to the Fire Department to the new poles. They showed a permit from the Fire Department to do so. Justice Gorman said that the Fire Department had no authority to grant such a permit, and held the prisoners for trial.

A number of persons have called upon Superintendent Walling and complained that the police attached to the various precincts are too enthusiastic in carrying out his order prohibiting the erection of new telephone and telegraph wires, as they arrest men employed by electric light companies and telegraph companies for repairing the lines already in use. The Superintendent in each case ordered that companies were entitled by law to repair such lines and should not be molested.

## The Thomson-Houston System in New Brunswick.

We have received the prospectus of the St. John, N. B., Electrical Light Company, controlling the Thomson-Houston system of arc and incandescent lights for the Province of New Brunswick. The company is organized with a capitalization of $100.000, divided into 10,000 shares, of $10 each. The stock is full paid and non-assessable. A reserve of $20,000, or 2000 shares, is placed in the company's treasury for enlarging and developing its business. The company is now firmly established. The demand for electric lights have far exceeded the expectations of the management; everything now indicating that a plant of 200 lights will be required within one year from the date of starting. Temporary power is now being used at the Saint John Bolt and Nut Works during the time necessary to erect a central station, which will be adjoining the works. This station will be built of brick, 100x40 feet, two stories high; engine and dynamo room, 40x60 feet; boiler room, 40x40 feet, with offices, workshops, storeroom and sleeping rooms for workmen will be in the second story. The company will have two boilers of 100 horse-power each, and two engines of 75 horse-power each. The whole is so arranged that any additional power that may be required can be added at any time. In order to carry out the plans for an enlarged business, the company is now offering a small amount of its stock for sale at $10 per share for the payment of plant and station. This company having acquired the right by license from the Royal Electric Co. of Canada, is the parent company for the Province of New Brunswick, and is now ready to enter into contract for constructing and building central lighting stations for cities or towns in said Province.

## A New Telegraph Trimmer.

We illustrate herewith the new tree trimmer, made solely by W. S. Lee & Co., Rochester, N. Y. It is an ingenious and effective little contrivance, the advantages of which telephone and telegraph men, for whom it was specially designed, are likely to appreciate. It answers

fully the object of keeping wires free from overhanging branches of trees. It is made with a thread on the inside of the socket, and can be easily screwed on a pole of any length. The blade or cutter is thrown out by a steel clock spring, and it is operated with a rope. The price is very low. The cutter can at any time be taken out and sharpened.

## New York Electrical Society.

At the meeting of the New York Electrical Society last week, the society voted to increase their library, and to invite inventors of electrical instruments to bring their inventions before the society and explain them. A committee was appointed to attend the International Electrical Exhibition in the interest of the society.

Prof. Vander Weyde, president, read a resumé of what the society had accomplished since its foundation. It was resolved to print this in pamphlet form, and to mail to each member a copy of the same, with an annexed list of all the members of the society at that date.

The president then described briefly the Redde Underground system of insulated wires. It consists of glass tubes in lengths of 12 to 16 feet, placed in iron pipes equally distanced from each other, with the spaces between filled with plaster of paris.

At the invitation of the society, Mr. Sinclair, of the U. S. Experimental Station (for gunnery), at Sandy Hook, gave a short description of the Howe system of underground wires in use by them. He said it was simply a covering of composition of tar, rosin, etc., surrounded with braided cotton, and then painted. Wires thus prepared were then laid on a trench 4 feet deep on a board, and fastened with a wooden cleat about one inch apart. They were covered with another board, and the trench was refilled with sand. These wires, he said, have worked satisfactorily through the winter, with the ground in some places covered with water and ice. There was no trouble from induction and the usual annoyances. Mr. Sinclair undertook to get, if possible, some test reports ready for the next meeting on July 4, which is expected to be the last meeting until the fall, and to be of a very interesting nature.

## Lartigue's Electric Railway.

M. Lartigue, the well-known French engineer, has applied electricity to the traction of the panniers or cars of his single-rail tramway. This tramway is, as we stated some time since, says *Engineering*, employed in Algeria for transporting esparto grass from the interior by the traction of camels. It was an easy step from animal to electric traction, and M. Lartigue has successfully taken it. At the recent Agricultural Exhibition in the Palais de l'Industrie, of Paris, an experimental line was shown on which five iron panniers, or double cars in the form of seats, were drawn by a dynamo-electric locomotive at the rate of seven miles an hour. The total weight of the five cars and the electric locomotive was about a ton, and the maximum power required was three horse-power. The dynamo of the locomotive was a Siemens $D_6$, and the generator, which stood about 100 yards from the line, was a Siemens $D_2$ dynamo capable of developing from 5 to 6 electric horse-power. It was driven by a Herman-Lachapelle steam engine. The total length of the line was 123 metres. It was built of 41 rails, each 3 metres long, and comprised curves of 7½ metres radius. The locomotive dynamo was carried by a platform car or pannier, and geared with a grooved driving-wheel 30 centimetres in diameter, which ran upon the rail. A rheostat to graduate the speed, switches to stop, start, and reverse the motor, and a seat for the conductor, were also carried by the locomotive, and ran on small grooved wheels. The current was brought to the dynamo by two insulated conductors, one connected to the rail, the other to the dynamo through small contact rollers in connection with the commutator. One switch was employed to start or stop the train by making or breaking the circuit; the other to reverse its motion by reversing the current. The rheostat, by interpolating resistance into the circuit, allows the strength of the current to be varied and the speed of the train to be increased or diminished as the case may be. The work was carried out by Messrs. Siemens, and under the direction of M. G. Boistel. The economy of the working is of course largely dependent on local circumstances.

## Devices for Ocean Telegraphy.

At the Royal Society's Conversazione, on the 11th inst., in London, a very interesting exhibit was made by Messrs. Latimer, Clark, Muirhead & Co. (Limited), of the electrical apparatus manufactured for the Mackay-Bennett Atlantic Cables, consisting of Muirhead's condensers and inductive resistances, exhibited in operation to illustrate their system of duplex telegraphy as applied to submarine cables.

An artificial submarine cable was formed of Muirhead's inductive resistances of the same electrical dimensions as the cable now being laid by the steamer Faraday, working duplex with Sir William Thomson's siphon recorders, one at each end of the line.

The artificial cable has the same ratio of resistance to capacity throughout its entire length as the real cable of which it is an electrical *fac simile*. The total capacity of the apparatus employed in this exhibit was 2,220 microparads equal to that of about 6,700 knots of submarine telegraph cable.

Such a display of apparatus is specially interesting, representing as it does the fruits of much labor and experience, and a large outlay of capital. Those engaged in submarine telegraph work can appreciate the practical advantages of such a system as that which practically doubles the carrying capacity of the cable.

CONKLING AND EDMUNDS TO ARGUE IT.—The statement is made that ex-Senator Conkling for the Bell Company and Senator Edmunds for the Drawbaugh supporters, will argue in the famous suit.

THE WOODHOUSE-RAWSON INCANDESCENT LAMP.—We are authorized by Messrs. Woodhouse & Rawson, of London, to say that there is no truth in the rumor that the Phœnix Company of this city are agents for their well-known Woodhouse-Rawson incandescent lamp.

DRAWBAUGH TELEPHONE INTEREST.—At a meeting of the Drawbaugh Telephone and Telegraph Company of the North west, held June 17, at its office, No. 2 Wall street, New York, the following-named gentlemen were chosen directors for the ensuing year: Albert M. Billings, Chicago, Ill., president of Home National Bank and president of People's Gaslight and Coke Company; Edward S. Lacey, Charlotte, Mich., member of Congress and banker; David M. Kelly, Green Bay, Wis., capitalist, railroad president and ex-speaker of the House in Wisconsin; James W. McDill, Afton, La., State Railroad Commissioner and ex-United States Senator; Frank T. Ransom, Nebraska City, Neb., attorney at law; James N. Burns, St. Joseph, Mo., member of Congress and ex judge of Common Pleas Court; S D. Woods, Kansas City, ex-mayor and merchant; E. B. Sopris, Trinidad, Cal., capitalist; C. Harvey Holman, Roxbury, Mass.; Lysander Hill, J. R. Bartlett, H. C. Andrews, Marcus Marx, G. C. Gorham, J. B. Reynolds, New York; Parker C. Chandler, J. P. Cook, Boston, Mass.; Frank Jones, Portsmouth, N. H. This company owns the Drawbaugh Telephone rights for the States of Michigan, Wisconsin, Minnesota, Iowa, Nebraska, Missouri, Kansas Colorado and the Territories of Dakota, Montana, Idaho, Wyoming and Utah.

## DEPARTMENT OF INQUIRIES.

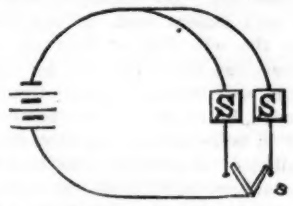
While we are pleased to answer in this department all questions of general interest to our readers, and do so without charge for time or expense, we must request those of our patrons who desire information for their personal interest, and who cannot be properly answered in this way to send us with their request a small sum, say from $1 to $5, to pay for the time and the expense incurred for their exclusive benefit.

NO. 76—TWO SOUNDERS IN PARALLEL.

"I wish to connect two sounders through a switch to one cell of battery, so as to make and break circuit on each independently of the other. Can I do it? And if so, what are the connections?"
W. H. W.

NEW MILFORD, Conn.

The diagram shows a manner of doing so. *S S* are the the two sounders, and *s* is a double switch, *i.e.*, with two




arms separately movable. It will be necessary to have your battery cell of such a low resistance that it will supply sufficient current to work both sounders, provided both are desired to be worked at once. You may work either or both with a key in the main circuit, according to the connections made through the double switch. Or you may put a key in each of the two branch circuits to the sounders, and work the appropriate sounder from its key.

NO. 77—PHONOGRAPH.

"Please let me know what is your idea of the requirements of a perfect phonograph; also, what is the reason that the phonograph invented by Edison has not come into more general use?"
TAYLOR, Texas. A. B. W.

The *perfect* phonograph is an instrument which will automatically receive, retain, and give up on call all sounds to which it is exposed, in pitch, tone, rhythm, and all the qualities inherent to sounds, such as speech, music, etc. This ideal instrument is yet to be invented.

Mr. Edison says, if correctly reported, that the reason why the instrument invented by him has not come into more extended use, is because he has not had the time to devote to perfecting it, owing to his close application to electric lighting matters. There seem to be the elements of a successful phonograph in the present instrument, and perhaps intelligent experiment devoted to its full development may produce something of truly practical value.

NO. 78.—ELECTRICAL EDUCATION.

"What would be a good course of study in Electrical Engineering, from the simple rudiments up? I am a young man and desire to get a thorough knowledge of electricity, and if you would mark out a course of study for me, I would be greatly obliged. I have a slight knowledge of the rudimentary principles, but I desire a thorough knowledge." A. H. S.
ST. LOUIS, Mo.

There is no royal road to such knowledge as you desire. If you can afford the expense, the best plan is to take the course on electrical engineering in some educational institution, like the Stevens Institute, or Cornell University. It will be necessary for you to have some knowledge of chemistry, mechanics, draughting, strength, and other qualities of materials, something of civil and mechanical engineering, as well as of electrical reactions. But if you cannot attend the right educational institutions, and must gain knowledge thus unaided, the best way is to study standard works on the subjects mentioned, but always accompanied by as much practical work incidental to the study as possible. A situation as assistant in an electrical workshop or laboratory, where you will take part in practical work is of prime assistance. Make sure by inquiry and reading that you understand the reason for everything done, and that you can repeat the operation. Study every instrument and association of instruments as to individual construction and assemblage, and the reasons therefore, and don't forget that which you have learned.

Remember that the electrical engineer is a repository of facts and theories from which may be drawn those which apply to the case in hand. Also, remember that you must not only know these things, but others must think you know them and can be of assistance to those who know less than you do.

NO. 79.—GALVANOMETER.

"Does a galvanometer, constructed with a disc needle which is placed above the coil, follow the law of tangents with anything like accuracy? And does its distance from the coil make any difference so long as it lies reasonably close?" B.
ITHACA, N. Y.

We answer "No" to both questions, qualifying the answer in the second case by adding, "not materially."

NO. 80.—ELECTRIC ARC.

"Why does a long arc make less noise than a short arc? Why does an undulating current produce a steady light such as the Brush?" R. F. O.
SOUTH BEND, Indiana.

The noise from an electric arc-light, run by a continuous current, comes from the boiling motion of melted carbon and impurities in the crater, or cup, of the positive carbon. When the arc is short, there is a greater accumulation of melted carbon at that point than there is in the case of a long arc. In the latter case, the carbon is oxidized, or combusted, as fast as melted and volatilized, and therefore does not accumulate to boil and fry enough to be heard. Intermittent and alternating currents produce noise at the arc by reason of the rapid rise and fall in the molecular motion thereat, produced by corresponding rise and fall in strength of currents supplying the arc. Undulating currents do not necessarily produce more steady lights than do continuous, intermittent, or alternating currents, providing the intermissions are not unduly prolonged, or the alternations insufficiently frequent. Persistence of vision prevents detection of very rapid intermissions and undulations in light. Unsteadiness in arc lights arises from two causes mainly—imperfect action of the regulating apparatus, and impurities in the carbons.

## THE TELEGRAPH.

A GOOD BUSINESS.—England exported telegraphic wire in May to the value of $600,000.

THE "FARADAY."—The "Faraday" passed the Lizard on the 25th, after laying the shore end of the Mackay-Bennett cable to Waterville. She goes to Cork to coal, and will then complete the cable.

SYNCHRONOUS MULTIPLEX.—Mr. Frank W. Jones, President Standard Multiplex Company, announces that the synchronous mutiplex system of telegraphy owned by the company is now in practical operation between Boston and Providence. An inspection of the office at either city is invited.

PERSONAL CHANGES IN PHILADELPHIA.—William G. Jones, Assistant Superintendent of the Philadelphia district of the Baltimore & Ohio Telegraph, has resigned and accepted the position of General Manager of the American District Telegraph Company of that city, a controlling interest in which has been secured by the Western Union Company.

INCIDENTS OF THE LATE CONVENTION.—It is stated that during the late Chicago Republican Convention George A. Townsend, with the aid of two stenographers, telegraphed to his papers 130 columns of dispatches. "Joe" Howard sent to the New York *Herald* daily from 4 to 7 columns, using the B. & O. wires, and says he did not note a single disappointment or break. Leander Richardson, using the Western Union wires, for the Boston *Herald*, is said to have made some very loud and cursory remarks one afternoon, on finding that a whole column of his dispatches had been carefully forwarded to the New York *Herald*, which did not know what to make of this unsolicited contribution to its columns.

THE FUTURE OF TELEGRAPHY.—President Bates says with regard to the future of telegraphy: "I think it will constantly increase, and at present there are not facilities enough. Men learn the use of the telegraph, and not only cannot do without it, but they demand the very best service. The true secret of telegraphy is to connect the important points. Take Chicago, for instance. The whole business of the Dominion of Canada in telegraphy is not equal to the business of the Western Union Telegraph office in the city of Chicago. All the business of the Pacific coast States and Territories is not equal to the business of Chicago city in telegraphy. Consequently, the demand is for connecting these great terminal points."

THE "DOUBLE TRAIN ORDER SYSTEM."—This system in dispatching trains by telegraphy is thus described by the Cleveland *Herald*: "If it was desired to telegraph train 12, eastbound, to remain at Shelby, there to await the arrival of train 5, running in an opposite direction, and telegraph train 5 to run to Shelby regardless of train 12, both Grafton and Shelby would be called up and given the orders simultaneously, instead of sending one dispatch to Grafton and another of a different tenor to Shelby. Three copies of the dispatch are taken in manifold—one for one operator, another for the engineer and another for the conductor. Both engineer and conductor must leave the train and go to the telegraph office and sign the order. The order thus signed is repeated to the dispatcher with the number 13, which signifies 'We understand.' Under this system such a collision as once happened on an Eastern road, where the operator ordered one train to go ahead and forgot until it had got away from him to order the opposite one to wait, would be impossible."

AGAINST GOVERNMENTAL CONTROL.—The Washington correspondent of the New York *Sun* writes: "Rarely has a session of Congress seen so many remonstrances in the shape of memorials against any proposed legislation, as have poured in during the last three months from every quarter of the land against the enactment of measures relating to the telegraph that will "increase the number of public officials and create a Government monopoly." These documents come by dozens and hundreds from town after town, all the way from Eastport to Brownsville and from Key West to Seattle. There must be thousands of them stacked up in the room of the committee to which they have been referred. Of course it will be said that the telegraph station employés have been set at work everywhere to prepare and circulate these petitions. If so, they have done their work thoroughly. But, after all, the employés in hamlets and even in towns are counted by units, while the signatures to these petitions are in scores and hundreds. They include many well known names, and their aggregate may be by this time among the tens or hundreds of thousands. Nobody has yet questioned in Congress the good faith or authenticity of any of these masses of petitions against the Government's embarking in the telegraph business.

## THE TELEPHONE.

OUTPUT OF BELL INSTRUMENTS.—The returns of the Bell Company for the month ending June 20, show that the output was 4568, as against 7038 for the corresponding period last year, being a decrease of 2470.

IN NEW ZEALAND.—According to figures just published the Postmaster-General of New Zealand reports that at the close of 1882 the total number of telegraph stations connected by telephone was 66. The exchanges at Auckland, Christchurch and Dunedin had a total of 417 subscribers. Wellington had 57.

BUTTE CITY, MONT.—A telephone line is to be erected between Butte City, Mont., and Anaconda, to be also extended to Philipsburg. It is owned by the Rocky Mountain Co. Missoula has been connected with the Butte Exchange, which now numbers 80 subscribers and is rapidly growing. The rate has been reduced to $5 per month.

THE BEGINNING OF THE END.—A dispatch from Harrisburg, Pa., of June 23, says: The taking of testimony in the case of the Bell Telephone Company vs. the People's Telephone Company, to restrain the latter from operating Drawbaugh telephones, which, it is alleged, embrace the patents of Mr. Bell, was closed to-day. Several hundred witnesses have been examined, and the suit has been in progress nearly three years. Counsel for the two companies will meet August 1 to fix the time and place for final argument and the submission of their briefs.

ROCKY MOUNTAIN TELEPHONE COMPANY.—At a meeting of the stockholders of the Rocky Mountain Bell Telephone Company, held at Ogden, Utah, June 9, 1884, 10 o'clock A. M., the following directors were elected for the ensuing year: C. F. Annett, J. J. Dickey, E. Dickenson, L. H. Kortey, Geo. Y. Wallace, C. W. Lyman, H. C. Hill, F. R. McConnell, L. B. Moore. In the directors' meeting that followed C. F. Annett was elected president, J. J. Dickey, vice-president; Geo. Y. Wallace, treasurer; L. B. Moore, secretary. The reports showed the business of the company to be in flourishing condition, and steadily and rapidly increasing.

## THE ELECTRIC LIGHT.

HOBOKEN, N. J.—At a meeting of the Common Council of Hoboken, N. J., on the 24th inst., the franchise for the introduction of the Thomson-Houston system was granted to Messrs. Pope, Sewell & Co., of New York, and all other franchises given previously to other companies were rescinded. The action of the Common Council was immediately approved by the Mayor.

STOCK IN GREAT DEMAND.—It will be seen from the announcement in our advertising columns, that the Executive Committee of the Board of Directors of the American Electric and Illuminating Co. have decided to close the subscription books for the new preferred stock of the company at par on *Thursday, July 10.* All orders for stock filed with the treasurer on which payments have not been made, must be completed before that date, and all who wish to secure any of the stock offered, but have not made application, would do well to lose no time. We understand that the response of the public has already been so general as to make it probable that the subscriptions will be scaled down and a proportional allotment made. There can be no doubt that with the necessary funds at its disposal, the company can do even better than in the past. If it did not, its dividend of 12 per cent on a capital stock of $250,000, with a surplus of $136,343, would be good enough for most people.

PROGRESS OF THE BRUSH COMPANY.—Mr. W. F. Swift, the secretary of the Brush Company, Cleveland, was in New York last week. Speaking of business prospects he said: Though the summer is the dull season in electric light business, we are selling more arc lights and machines and lamps than were ever sold before at this period of the year. Our factory is busier than ever before at this season. Our company is not, I think, an exception in this respect, and this is a matter of particular public interest, because the antagonists of electric lighting have said with constant reiteration that the business was at present a craze and would gradually drop away. The real fact is that the use of electric light apparatus is increasing all over the country just as it is in New York City, and it is increasing abroad as rapidly as in this country. The demand seems to keep up uniformly in all directions. The storage battery, which we began to manufacture about a year ago, is going into use quite generally. We have been shipping to fill orders as fast as facilities would permit their manufacture. The electric railway invention of Messrs Bentley & Knight, of New York City, is about to be given its first thorough and practical test in our city, on a mile and a half extension of the Garden Street Railway.

## MISCELLANEOUS NOTES.

A NEW LIGHTNING-ARRESTER.—A number of Philadelphia telegraph men witnessed the successful trial of a new lightning-arrester at the works of the Maxim Electric Light Company the other evening. The instrument is the invention of one of the employés of the Baltimore & Ohio Telegraph Company. It has not yet been applied permanently to any cable crossings or lines, but the Baltimore & Ohio Company will attach it to their cables at several important crossings this week. In appearance the new instrument is very simple. It consists of two discs, one at each end of a steel axis, and a number of fine steel wires extending between them. One of the wires rests against small steel posts, in which the cable and land wires end, and forms the connecting link between them. When the lightning strikes the land wire, it makes its way toward the cable, and is conducted through the steel posts to the fine wire on the arrester. The wire is too small to bear anything but a normal amount, and melts at once, breaking the connection, and allowing the heavy current to be diffused. The instrument is arranged with a spring, which turns the disc or cylinder, and at once brings another small wire into position, so that messages can be sent as before. It is intended to attach them to telephones and telegraph instruments to prevent danger from any extraordinary currents.

## STOCK QUOTATIONS.

Telegraph, telephone and electric light stocks were quoted as follows on Thursday at the Electric, Manufacturing and Miscellaneous Stock Exchange, and at the Stock Exchange:

TELEGRAPH.—Am. Cable, a 49½; American Rapid, b 40, a 50; B. & M. Co., a 90; Commercial Telegram Company Pref'd, a 109; Commercial Telegram Common, a 95; Harlem District Telegraph Co., b 2, a 2.50; Manhattan Telegraph, b 10, a 85; Mexican, b 125, a 147; Postal Telegraph (stock), b 4.87, a 6; Postal Telegraph Bonds, 1st, 6 per cent., 4.50, a 46; Western Union, b 51¾, a 51⅞.

The *Mail and Express* says: Brokers who have not heretofore advised buying it say that Western Union is cheap on its merits. It is paying 7 per cent. dividends and almost 14 per cent. on the

purchase price. The financial situation is not much more favorable to new telegraph enterprises than it is to railroad building. It would be difficult to start any new combination, and may not be easy to keep the present opposition vigorous. The law requiring telegraph wires to be put under ground is a much less serious matter for Western Union than for any new enterprise. Western Union has its trunk line wires under ground already and does not need to string new wires over head. A new company would be put to enormous expense in order to compete with Western Union in this city on that account. The Chicago Convention this month was worth a sum, estimated all the way from $100,000 to $500,000 to the Western Union Company. Another convention will be held next month and the political canvass follows. Returns from the test offices show Western Union to be gaining about as much in business as it has lost in rates. The testimony of commission brokers is that parties buying fractional lots of stock to lay away, select Western Union oftener than any other one stock. The price is very near the bottom. All these things seem to make Western Union one of the cheapest stocks in the market.

TELEPHONE.—American Bell, b 153, a 155; American Speaking, b 100, a 125; Currier Telephone Bell, b 3; Colombia and Panama, b 24 50, a 25; Continental, b 10; Dolbear, b 5, a 10; Erie, b 21, a 22; Hudson River, b 40, a 85; Inter-Continental, b .50, a 2.50; Mexican Central, a 3; Missouri & Kansas, a 10; Molecular, b 5, a 11; New England, b 20, a 22; New York, b 45, a 60; New York and New Jersey, b 20, a 85; New York and Pennsylvania, b 30, a 65; New York State Overland, b 10, a 15; People's, b 5, a 10; People's (N. E.), b 1, a 8; Solenoid, a 90; Southern Bell, b 95, a 125; Southern New England, a 175; Tropical, b 1.25 a 1.75; West India Telegraph and Telephone, b 1, a 1.25.

The latest rumor is that the quarterly dividend of Erie telephone will be reduced from 1 per cent. to ¾ of 1 per cent. A fortnight ago it was declared that the usual amount would be paid. The *Traveller* says it is understood that the directors are practically agreed upon the reduction proposed, especially as by making it the company will be able to pay from its gross earnings all the running expenses, the entire construction work, and a very liberal amount quarterly on the floating indebtedness, which now amounts to about $160,000. The company is now increasing its subscribers at the rate of from 250 to 300 monthly, and its construction expenditures amount to from $10,000 to $15,000 per month. The reduction of the dividend amounts to $12,000 per quarter.

The Boston *Herald* of the 26th says:

Erie telephone was steady at 20½@20 to-day. President Ingham says a reduction of the quarterly dividend has not been in contemplation. As pointed out in this column in connection with the annual report, it was, and is, with Erie, as with the New England company, a question of suspension of dividends or borrowing for construction. New England chose to pass dividends, and thus far Erie has taken the opposite course. New England also sold at 20½@20.

Bell telephone was stronger at 160. The net output of telephones the first four months of this and previous fiscal years has been as under, the month ending on the 20th:

| | 1881. | 1882. | 1883. | 1884. |
|---|---|---|---|---|
| March | 4,593 | 5,192 | 4,739 | 3,252 |
| April | 5,331 | 6,690 | 7,342 | 4 483 |
| May | 5,757 | 7,469 | 6,758 | 5,023 |
| June | 5,735 | 6,362 | 7,038 | 4,568 |
| Totals | 21,416 | 25,713 | 25,877 | 17,326 |

The Boston *Advertiser* of the 26th, thus quotes the local market: In telephone stocks, New England closed ¼ lower at 20, and Erie declined 1 to 20; American Bell advanced 6 to 160, which was the last sale; on the last call 155 was bid, 160 asked.

ELECTRIC LIGHT.—American, b 2, a 4; Baxter, b 22, a 25; Brush, b 50, a 80; Brush Illuminating, b 30, a 50; Daft, b 80; Edison, b 80, a 100; Edison Illuminating, b 30, a 75; Edison Isolated, a 90; Edison European, b 9, a 15; Swan Incandescent, b 15, a 40; United States, b 75, a 95; United States Illuminating Co., a 90.

Kohlsaat & Co., No. 30 Pine street, furnish the followin quotations for miscellaneous securities:

| | About. | | About. |
|---|---|---|---|
| American Elec. Light | 9 | Am. Bell Telephone | 155 |
| Brush Electric | 75 | Mexican Telephone | 19 |
| Edison Electric | 100 | N. J. and N. Y. Telephone | 56 |
| Edison Illuminating | 62 | N. J. and Pa. Telephone | 57 |
| Edison Isolated | 73 | People's Telephone | 20 |

## BUSINESS NOTICES.

A TEMPTING SPECIAL OFFER.—We direct attention to the special offer of C. E. Jones & Bro., Cincinnati, O., to be found on our fourth advertising page. It will be noticed that the offer is limited to August 1.

"FOREARMED IS FOREWARNED."—Is the engineer anxious as to the steam pressure? Do employés and superintendents running engines and boilers wish to remove all doubt and uncertainty as to the reliability of their subordinates? These cases and all others like them are met by the use of one of Edson's Recording and Steam Pressure Gauges placed before the interested person, by which due notification is given at all times as to water in boiler, steam pressure, etc. These gauges can also be availed of in getting uniformity of action from a dynamo-electric machine, showing all variations of speed during action. An Edson gauge is better than the best insurance policy.

ELECTRO-MEDICAL APPARATUS.—The use of electricity as a remedial agent is becoming more and more popular among scientific physicians, many of whom, however, are imposed upon by the cheap, inferior articles they purchase, and seek to cure disease without benefit to the patients and with discouragement to themselves. Had they purchased from the first a good article, such as the apparatus made by the Jerome Kidder Company, they would have obtained better results. The machines of this company are specially constructed for medical purposes, and were awarded the highest premium at the American Institute in the fall of 1883, over three competitors. Considering the indorsements they have, we do not hesitate to recommend them.

# OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

**Edited by N. S. KEITH, Electrical Engineer and Expert, 9 Murray Street, New York.**

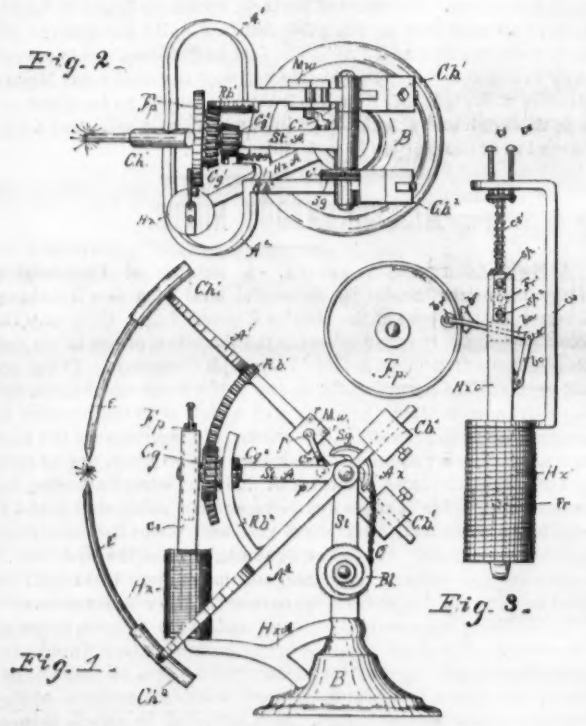
## PATENTS DATED JUNE 10, 1884.

**Apparatus for Distributing Electricity;** Alphonse Isidore Gravier, of Paris, France ..... 300,068

The invention consists, first, in placing the translating devices in a series of derived branches, and in including in each branch, or in such branches as it may be desirable to employ it in, an automatically or electrically adjusted rheostat or resistance apparatus, whereby the current through said branch or branches and the translating device or devices included therein is maintained uniform at a given strength and intensity. Furthermore, it consists in various combinations designed to utilize secondary batteries in connection with dynamos and receivers of electricity.

**Electric Lamp;** Mirabeau N. Lynn, of Indianapolis, Indiana, Assignor to the Ohio Power & Light Co., of Dayton, O..... 300 095

The carbons being placed in the holders, a current is sent through the helix from the dynamo. The core is drawn into the helix by the force of the electric current, and the spring in the barrel *Bl*, pulling down upon the chain *C*, draws the arm $A^2$ upward. This movement by means of rack-bar $Rb^2$




transmits the motion, through the differential gears $Cg'$ $Cg^2$ and rack-bar $Rb'$, to the arm $A'$, drawing it downward, bringing the carbon-holders together. The gears are relatively sized, so as to bring down the arm $A'$ faster than the arm $A^2$ is moved upward, as the upper carbon consumes faster than the lower, and this arrangement focuses the light at one constant point. The pressure of the spring in the barrel *Bl* is so graded that it exerts a constant and uniform strain upon the arms $A^2$ $A'$ at any point of their movement. The face-plate *Fp*, as before mentioned, is mounted upon the same sleeve with the differential gears, and turns in the direction they turn, actuated by the same force—the spring in the barrel *Bl*. As the current passes through the helix, it exerts a force to withdraw the core into the helix—that is, it pulls it down against the force of the coiled spring *cs'*, which is fastened to the top of the core. As the core is pulled down it pulls down the arm *bc*, the joint *K* is drawn toward the core, and the brake-arm *ba* drops into such a position that the rubber *br* grips the periphery of the face-plate, which is moving in the direction of the arrow, Fig. 3, and arrests its motion and reverses its movement, and this force of the current is transmitted through the gears to the arms $A'$ $A^2$, and forces the carbons apart. As the arc lengthens, the current weakens, and the power of the spring in the barrel *Bl* remaining uniform, now greater than that of the current, draws the carbons together again, and these forces, thus acting and counteracting, insure a medium distance for the carbons and the proper arc.

**Conduit for Telegraph Wires;** Wm. Magner, of Philadelphia, Pa., Assignor of one-half to John M. Doyle, of same place..... 297,992

Various details of construction of a conduit of terra cotta, etc.

**Compound Telegraph Cable;** Peter H. Vander Weyde, Assignor to the Vander Weyde Electric Co., of New York..... 300,034

Consists in the combination of suitable keys or commutators and conductors, with any desired number of parallel insulated telegraph or telephone wires, either bound together in a cable or otherwise carried in the same direction side by side, so that while each wire may serve independently as the conductor for a direct electric current in the customary manner, all the remaining wires in the system not at the moment transmitting a direct current shall serve conjointly and independently of any ground-connection as conductors for the return current, either alone or in combination with an extra auxiliary wire reserved exclusively for the return current.

**Derived Circuit for Clearing-Out Annunciators;** Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Co., of same place..... 300,144

Consists in placing the clearing-out drop permanently in circuit between the connecting plugs, and providing mechanism whereby the operator's outfit may be looped around the clearing-out drop.

**Electric Annunciator and Circuit;** Theodore N. Vail, of Boston, Mass..... 300,168

Consists in the following devices and combinations: first, an annunciator capable of responding to the changing electrical condition of a main circuit and of giving an absolute drop-signal, and furthermore provided with resting devices actuated by an electro-magnet in a local circuit; second, the said annunciator, or an instrument substantially equivalent thereto, combined with a main circuit and a local circuit, one of the said circuits including the signal giving and the other the signal-setting magnet; third, the convenient arrangement of the said signal-giving and resetting instrumentalities and the said main and local circuits with reference to a switch-board for connecting any two main circuits together, and two suitable circuit-closers for the automatic or manual operation of the resetting device.

**Electric Bell and Annunciator;** David Rousseau, of New York City..... 300,134

Consists in the special construction and arrangement of the several parts of the instrument.

**Electric Bell;** Edgar W. Hazazer, of New York, N. Y..... 300,253

Various details which have for their object making the instrument more compact, conveniently attachable to walls, etc., to protect from dust, insects, and from accidental breaking of connections.

**Electrical Cauterizing Apparatus;** Eli T. Starr, of Philadelphia, Pa., Assignor to the S. S. White Dental Manufacturing Co., of same place..... 300,155

One of the two needle-electrodes only is heated to incandescence.

**Electric Clock;** Solomon Schisgall, of St. Petersburg, Russia..... 300,139

Mechanism for a pendulum clock, actuated by a current from a galvanic battery.

**Electric Door-Lock;** Conrad Wuest, of Zurich, Switzerland..... 300,334

Consists of a spring-bolt lock or latch, which can be opened by an electric current, and is reset automatically by the opening or closing of the door, so that it will latch when the door is shut, and be in a position to be reopened by the electric current.

**Electric Motor and Dynamo-Electric Machine;** Eli T. Starr, of Philadelphia, Pa., Assignor to the S. S. White Dental Manufacturing Co., of same place..... 300,154

Various details calculated to improve an old-style Siemens H armature machine.

**Electric Railway Signal;** Louis Finger, of Melrose, Mass., Assignor, by mesne assignments, to the Hanlon Electric Signal Co., of Portland, Me..... 300,238

Consists in a rotary signal combined with an electric circuit having a battery and a circuit-closer, an electro-magnetic motor having independent divisions or sections and switching devices, whereby successive closures of the circuit are caused to energize the sections of the motor alternately, and thereby cause the signal to alternately display a danger and a safety color. It also consists in the provision of an automatic locking device to secure the signal in each position, and automatic means for unlocking or releasing the signal when the circuit is closed.

**Galvanic Element;** Wilhelm Wenzel, of Vienna, Austria-Hungary..... 300,176

A cell divided by two porous partitions into three divisions. The electrodes are in the outer divisions, and the inner division has a liquid in it differing from the two liquids in the other divisions.

**Manufacture of Electric Conductors;** John J. Williamson, of Boston, Mass..... 300,179

A hollow ingot of steel is made, and the longitudinal cavity is filled with melted copper. The ingot is then rolled and drawn as for making wire or other conductors. The copper is then within a steel tube or shell.

**Multiple Circuit Closer;** Wm. F. C. McCarty, of St. Petersburg, Russia, assignor to James F. Pierce, Trustee, of New York..... 300,098

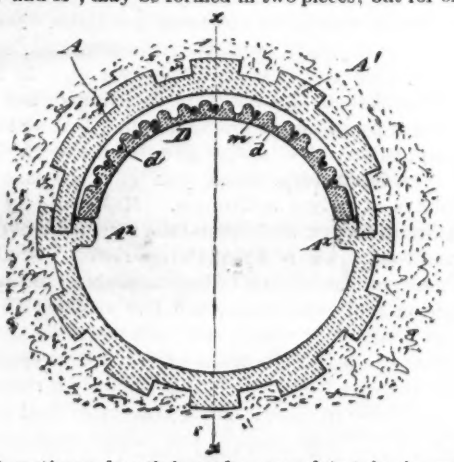
Consists of details of an apparatus used for closing several derived circuits at one movement.

**Process of, and Apparatus for, Electro-Depositing Copper, Brass, etc.;** Wm. Henry Walenn, of Islington, County of Middlesex, England..... 300,035

The electrolyte is a solution of cyanide of potassium and tartrate of ammonium, with an addition of cupric ammonide. The electrolyte is worked hot, and in order to compensate for evaporation a tight cover and condenser are used.

**Underground Conduit for Electric Conductors;** Augustine Campbell, of Metuchen, N. J..... 300,210

*A* is the main body of the exterior, and *A'* a series of longitudinal ridges of dovetail section. *B* is a bed of concrete. $A^2$ $A^2$ are internal longitudinal ridges. The tube *A*, with its several ridges *A'* and $A^2$, may be formed in two pieces; but for ordinary



sizes each section or length is made a complete tube in one piece. *D D*, etc., are the internal pieces. They may be formed, like the main parts *A* by forcing properly-tempered clay through a die of the required form. A cross-section of each piece *D* is nearly half of a hollow cylinder, with the exterior grooved longitudinally. The longitudinal grooves are marked *d*.

**Secondary Battery;** Augustus G. Davis, of Baltimore, Md..... 300,052

The plates are provided with extensions, and these extensions are thickened at the places of making the connections between the extensions.

**Spring-Jack for Telephone Systems;** Charles E. Scribner, of Chicago, Ill., Assignor, by mesne assignments, to the Western Electric Co., of same place..... 300,143

Consists in connecting the calling-battery with a point near the lever of each spring jack, and so constructing the plug that the switchman may by means of the plug connect any subscriber's line with a contact point, connecting with the calling battery.

**Telegraphic Relay;** James S. Lamar, of Augusta, Ga..... 300,269

Consists in a vibratory steel magnet acting by its own attraction upon the core of an electro-magnet to break circuit, and by mutual repulsion between the electro-magnet and the steel magnet to make circuit.

**Telegraphic Transmitter;** Nicholas J. Bishoprick, of Brooklyn, N. Y..... 299,949

Consists in a machine for electrically transmitting telegraphic symbols or characters previously prepared, and comprises rotary contact surfaces moving in opposite directions, and suitably insulated from one another, and arranged in an electric circuit, combined with mechanism operable at will to bring in contact with said surfaces movable types or blocks containing the said previously-prepared characters or symbols, the active surfaces of which are electro-positive to the rotary contact-surfaces, whereby the characters or symbols on such types or blocks are electrically transmitted.